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The Role of Aerobic Fitness in High Intensity Efforts, Part II

by Thomas Kurz

“Aerobic training causes harmful changes in skeletal muscle fiber type, hormonal secretions and force output characteristics. The fastest, most powerful muscle fibers become slower and more resistant to fatigue. ... Aerobic exercise also produces the catabolic hormone cortisol, which is antagonistic to anabolic hormones such as the human growth hormone and testosterone. ... A fighter may have a 20-30 second flurry, rest for 10-15 seconds and so on. ... People confuse being out of breath as a need for more aerobic conditioning. ... Fighters and forms competitors depend on sharp, crisp techniques. Aerobic training hurts these athletes even more than contact fighters.” (“The Problem with Aerobic Training.” by Charles I. Staley, B.Sc., MSS [Vice President of Program Development for the International Sports Sciences Association] in *M. A. Training*, Vol. XXV, No. 3, May 1998, p. 24.)

The statements above contain misconceptions and inaccuracies. In the previous issue of Stadion News I have dealt with some of these and in this issue I take up the remainder.

Now, about the importance of aerobic energy production on the example of fighters. How do fighters breathe during a fight? They breathe deep and very often, much more often and much deeper than at rest. During intense exercise the volume of air fighters breathe is up to 10 times more than at rest and remains elevated during recovery (McArdle, Katch, and Katch 1991). Fighters’ heart rate rises above 200 beats per minute (Dziasko et al 1982, Bujak

1996). What is all this extra air and blood flow for? It is to deliver more oxygen to the working muscles! Without oxygen the buildup of lactate (an ester of lactic acid) would stop muscles from working (McArdle, Katch, and Katch 1991). Also, oxygen is necessary for resynthesis of ATP (McArdle, Katch, and Katch 1991). Which fighter can attack more frequently? The one who recovers quicker after “a 20-30 second flurry.” Which one reacts better? The one who is less fatigued and can move faster—which to a great degree depends on the ability to oxidize lactate built up during the flurries.

What Mr. Staley writes would be true if during the fight you punched or kicked once in a while and then strolled about the ring. But you know that is not the way of a fight, which is why you need to exercise in all energy zones—anaerobic-alactacid for maximal power in single movements, anaerobic-lactacid for a series of attacks, mixed aerobic-anaerobic for prolonged efforts such as in maneuvering in the ring or in wrestling, and aerobic for quick recovery between actions. A typical judo match consists of several periods of high activity lasting 10-30 second each followed by a period of lower activity that on the average lasts 10 seconds (Sterkowicz 1996). A fighter with greater aerobic fitness recovers better within this very short slowdown than one who is less aerobically fit.

What is the source of the misconception about the part aerobic training plays? Probably it lies in not differentiating between aerobic exercises in general and *aerobic exercises to exhaustion*, such as marathon

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We thank Mr. David Cruz, for sending us his photo showing the results of using our stretching method. Mr. Cruz is a kung-fu instructor in Hendersonville, Tennessee. Here is what he wrote:

“I have sent you pictures of my chair-split in the past and at this time I am sending you a picture of my side kick, which I held for at least five seconds for the picture.”

The Role of Aerobic Fitness in High Intensity Efforts, Part II

(continued from page 1)

running. Another source may lie in a superficial study of exercise physiology textbooks. For many years it was believed (see the 1991 edition of the otherwise informative popular exercise physiology textbook the *Exercise Physiology* by McArdle, Katch, and Katch) that during the first 10 seconds of effort most energy is supplied by the ATP-PC system (anaerobic-alactacid zone of effort), that the lactic acid system (anaerobic-lactacid zone of effort) supplies most of the energy for efforts lasting between 10 seconds and 3 minutes, and that only after 3 minutes does the oxygen system start to supply significant amounts of energy (mixed anaerobic-aerobic and aerobic zones of effort). It was believed that the oxygen, or aerobic, system is mobilized too slowly to supply energy during short, intensive efforts such as sprints.

Results of recent research undermine this belief. The ratio of energy derived aerobically during intensive effort was in the past underestimated due to using the imprecise 'oxygen debt method.' Results of research conducted using the most accurate method (the accumulated oxygen deficit method first used by Medbø et al in 1988) show that the aerobic system contributes more energy in short intense efforts such as sprints than previously thought.

It turns out that between the 20th and the 30th second of an all-out effort, aerobic sources provide as much energy as anaerobic. Right from the 10th second of such an effort, the aerobic system contributes at least 20% of the energy. Its contribution grows steadily to equal that of the anaerobic system between the 20th and 30th second, and then, after the 30th second of effort, most energy is contributed by the aerobic system (Gastin and Lawson 1994). The practical conclusion of these researchers is that a training program for high intensity efforts, such as a 400-meter run, ought to include both anaerobic and aerobic exercises in the proper ratio. This news is not

really new, because research done in 1962 by Volkov, Lapin and Smirnov (Volkov et al 1962 quoted in Ulatowski 1981) showed that 37% of the variance of a sprinters' form is explained by aerobic fitness.

What if your actions do not last as long as 20 seconds? Shouldn't you then have no need for aerobic fitness? Consider the example of Olympic weightlifting. Olympic weightlifters' competitive lifts are *single*, very brief efforts of maximal intensity. Theoretically energy for such anaerobic-alactacid efforts (anaerobic efforts that do not raise the level of lactate) ought to be supplied by the phosphagen system previously referred to in this article as the ATP-PC system. That is the theory and it applies only to single lifts. In training practice, however, weightlifters do *series* of various lifts—whole snatch and pull-and-jerk as well as parts of these lifts and other exercises such as squats and deadlifts. Single lifts are repeated several times with a few minutes of rest after each lift, or lifts are done in sets of 2 or more repetitions, each set then followed by a few minutes of rest. Research on weightlifters showed that it was not only the ATP-PC system that supplied energy during workouts. The raised levels of lactate after a workout revealed the involvement of the lactic acid system, too (Hübner-Wozniak, Chrusciewicz, and Piotrowski 1995). The measurements were taken during two workouts. The main part of the first workout consisted of five snatch lifts and five pull-and-jerk lifts. The main part of the second workout consisted of six squats and six pull-and-jerk lifts.

Some of the weightlifters had higher concentrations of lactate than others (for example, 6.44 mmol/l versus 2.62 mmol/l), which changed very little during 20 minutes of rest after a workout. According to the researchers, this was caused by the low aerobic fitness of those weightlifters. Weightlifters with sufficient aerobic fit-

ness had lower concentrations of lactate and recovered faster (their lactate concentrations were very close to the preworkout level after 20 minutes of rest). This is important because high acidity within muscles lowers the ability to perform short maximal power efforts (Hübner-Wozniak, Chrusciewicz, Piotrowski 1995, Sharkey 1990, and McArdle, Katch, and Katch 1991).

Concentration of lactate "begins to increase in the exercising muscle well before the phosphates reach their lowest levels. ... Energy for exercise is not merely the result of series of energy systems that 'switch on' and 'switch off,' but rather the smooth blending with considerable overlap from one mode of energy transfer to another" (McArdle, Katch, and Katch 1991).

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Self-Defense Tip

Some more on selecting a self-defense instructor. Here is what [Mac Mierzejewski](#)—author of *Power High Kicks with No Warm-Up!*—has to say on this:

"Take a good look at the instructor. If the instructor tells you that he was in Special Forces and 'his whole life fought full-contact' but has a big belly and no scars on the face, then something is wrong.

"What I want to say is that many years of hard physical exercise will be evident even in old age. [Athletes tend to stay athletes even as they age.]

"I believe that instructors who exercise together with students are preferable to those who refrain from physical effort and merely command.

"I advise against joining secretive styles, that require advance payment for several months of

instruction. If the instructor and school are good, then the school is usually open and visitors can see several well-trained people exercising there, not just lots of trophies and diplomas.

"If the students are fit then the school is worth trying. If the students, other than the beginners, are obese or unskilled, then their training methods are ineffective."

Sports Skills and Strength Training VI

by Thomas Kurz

In the previous article you were introduced to the concept of sport-specific strength exercises. In this article you will learn about the danger of an inappropriate use of such exercises.

Danger of Early Specialization

If sport-specific exercises are introduced too early in an athlete's career, at the expense of general exercises, initially the sport-specific skills are developed at a high pace. Later, though, the athlete hits a plateau because the skills were developed without a foundation of general development. Improving performance at the stage of specialization (when the athlete does mostly sport-specific exercises) by resorting to general exercises is difficult if not useless. The neuromuscular patterns of the techniques (timing, amount of force, velocity, and the angles of movement) are already formed and the general exercises can't alter them.

Start your long-term training program with general strength exercises and progress to sport-specific strength exercises. (Definitions and examples of general, directed, and sport-specific strength exercises are on page 4 of *Stadion News*, Summer 1997.)

From General Exercises to Sport-Specific Exercises

General strength exercises lay the foundation for sport-specific exercises by strengthening all major groups of muscles around each joint in a balanced way. General strength exercises thus prevent injuries.

Initially general exercises (strength or endurance, for example), done concurrently with technical training, improve the level of technical skill. They then cease to be effective in this respect, and for more improvement in sport-specific skills, you must introduce the so-called directed exercises, which are more closely related to the techniques. After some time even these exercises lose their effect on the technical proficiency of the athlete, and you need even more specialized exercises for further progress. If you continue the general exercises (strength, speed, endurance, coordination) throughout your athletic career, you will show gains in the abilities they are designed to develop, but only if measured by general tests. In other words, performing general exercises will increase profi-

ciency mostly in performing these general exercises. If you gain mass and strength from performing general strength exercises, but the neuromuscular patterns of these exercises do not resemble those of your competitive technique, the strength gain in sport-specific technical tests or in competition will be disproportionately low to the amount of work done and the general strength gain. The same is true for other physical abilities such as endurance or speed.

Coaches that want quick success, especially with young athletes, develop mainly the physical abilities that are dominant in a given athletic event. Some use exercises called "exercises of direct purpose" or "immediately applicable exercises." In such a system, a shot putter practices the technique only by putting shot, develops strength by standard weightlifting exercises, and speed by short sprints and starts. Such an approach results in a considerable initial improvement of sport-specific performance in shot put but a stagnation of it in only a few years, after which permanent progress of the athlete is limited to strength as measured by standard weightlifting methods and speed measured by the standard 20 meters sprint from starting blocks (Wazny 1981).

The proper way is to use a wide variety of exercises, some of which have similar rhythm and form to those of the athlete's specialty, to develop gradually sport-specific strength, speed, and coordination and on that base perfect the technique (Wazny 1981).

General Preparation Must Be Sport-Specific Too

The general preparation of athletes is getting "specialized" as training is becoming more sport-specific in the course of an athletic career (Matveev 1981). This does not mean that general exercises become more similar to the sport-specific ones. Rather it means that they are selected to match the changing needs of an athlete subjected to the increasing sport-specific training loads. The exercises of general preparation on one hand have to compensate for imbalances created by the growing training load in sport-specific exercises

and, on the other hand, to use the positive transfer of training to the fullest and to limit the effect of any negative transfer. These are the reasons why general preparation differs in various sports (Matveev 1981).

Here are two examples of specialization of general strength exercises: the first is from long-distance running and the second from discus throwing.

Long-distance runners lift weights at the beginning of their training cycle. By doing various weightlifting exercises, runners strengthen all muscles, among them those that affect the efficiency of movement but are not the most stressed in running; for example, the muscles of the upper body. These exercises are done in long sets, at slow pace, and without breaks between sets of different exercises so the athlete works continuously. The resistance in these exercises is set to permit initially about 30 repetitions, and as an athlete progresses that resistance remains unchanged but the number of repetitions increases. The slow pace permits performing the work aerobically, because this is what long-distance running requires (Wazny 1981).

Compare the above general strength exercises for long-distance runners with general strength exercises for discus throwers. Rachmanliev and Harness (1990) give the example of Bulgarian female throwers: full squat, half squat, bench press, clean, and snatch, with resistance ranging from 40%-100% of the athlete's maximum and with rest breaks up to a few minutes between sets. Metric tons lifted per workout goes from 18 to 3, and the number of workouts with weightlifting going from 4 to 2 per week. (The closer to the main competition, the less tonnage lifted and the fewer weightlifting workouts.) These figures do not include other general strength exercises for throwers, such as jumps with weights and throws of various implements other than a discus.

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Q and A on STRETCHING and TRAINING (continued from previous issue)

Study these typical questions on stretching and training carefully. You may find information that relates to questions of yours. Questions are in **boldface**.

■ **I am a martial artist (wu chuan kung fu) whose goals involve personal development and health. For those of us who do not have a competitive season but who are trying to maximize our physical condition, how should we organize our training? In an earlier e-mail response, you told me that during the preparatory phase, judoka [or] karateka should do hundreds of reps of sit-ups, push-ups and squats. Should I designate a time of year as a preparatory phase and return for a few months each year to the high-rep sets? Or is there some other way I should work these high rep sets into my training routine?**

You can designate a time of year as a preparatory phase that can last from three months for beginners to one month for advanced athletes. After the initial use as an introduction for new strength exercises, you can do the really long sets (100 and more) with low resistance if you feel excessive muscle soreness after a period of doing heavy weights. Long sets are also good for relieving muscle spasms of muscles overworked with heavy loads. (I know it sounds like a paradox, but that's the way it is).

And yes, there is some other way. You can combine general conditioning (strength or endurance, for example), with sport-specific conditioning through the whole year. This can be done either within the same workout or within consecutive workouts. (For those athletes who do compete, the further you are from a contest, the greater can be the proportion of general conditioning.) Pay attention to your body to decide what exercises to do and which to drop. For example, if your feet hurt when practicing jumping kicks or kicking a heavy bag, then kick less and do more general strength exercises for your feet (to strengthen their arches).

General conditioning has the task of accumulating morphological and functional changes. On the basis of these accu-

mulated changes—for example, muscle hypertrophy—sport-specific exercises can be done in which efforts are more intensive. The sport-specific exercises can be so intensive that while causing your performance to improve they eventually weaken some of the links in the movement chain. To put it in another way—structures of your body might not adapt to intensive sport-specific exercises at the same rate as your capabilities. This means that from time to time you have to go back to general exercises or you need to do some general exercises either during the same workouts or at least during the same microcycles (weekly schedule of workouts) as your sport-specific exercises.

■ **I have the books *Stretching Scientifically* and *Explosive Power and Jumping Ability for All Sports*. I am trying to design a training schedule that combines training tips from the above resources. On page 64 of *Stretching Scientifically*, you write that “work on speed or technique before working on strength, work on strength before working on endurance.” But on pages 24–27 of *Explosive Power and Jumping Ability for All Sports*, the authors say that endurance should be the foundation, and one needs strength before speed. The information in the two books seem contradicting to me.**

There is no contradiction between these two statements. If you read the whole paragraph which starts on page 63 and ends on page 64 of *Stretching Scientifically* you will see that it refers to a weekly schedule of workouts while the one on pages 24–27 of *Explosive Power and Jumping Ability for All Sports* refers to periods of a macrocycle (a several months-lasting cycle of training).

■ **Would the book *Explosive Power and Jumping Ability for All Sports* provide some information on plyometrics for kickboxing and some exercises (applicable for kickboxing) that one could follow?**

Yes. See pages 100–109 of *Explosive Power and Jumping Ability for All Sports: Atlas of Exercises*.

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